FRESHWATER MUSSEL SURVEY PROTOCOL FOR THE SOUTHEASTERN ATLANTIC SLOPE AND NORTHEASTERN GULF DRAINAGES IN FLORIDA AND GEORGIA

United States Fish and Wildlife Service,
Ecological Services and Fisheries Resources Offices

Georgia Department of Transportation,
Office of Environment and Location

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ABSTRACT

Within the Southeastern Atlantic Slope and Northeastern Gulf Drainages of Alabama, Florida, and Georgia, the U.S. Fish and Wildlife Service (Service) has identified a need for a standardized mussel survey protocol that can be used across physiographic provinces. The Service and Georgia Department of Transportation (GDOT) worked cooperatively to develop this DRAFT Mussel Sampling Protocol (Protocol) to ensure that it fulfills the dual objectives of the Service and GDOT. However, its intended use is for all agencies and applicable field biologists. This Protocol is designed to serve as a tool to qualitatively determine if federally protected species are present within an area. The Protocol ensures a level of consistency, comparability, and Quality Assurance/Quality Control among surveys and should be applied for all mussel surveys that are funded, permitted or requested by the Service in this area. It establishes minimum qualifications of surveyors, discusses permit requirements, suggests preliminary research needs, details a standard operating procedure for qualitative surveys, and provides guidance for deliverables. The standard operating procedure outlines two methods (minimum length and multiplier factor) for determining a prescribed search area (PSA) to ensure that appropriate stream coverage is achieved among various projects while searching for mussels. Surveyors may choose to bypass the qualitative survey (if the area is known to support listed species), and opt for a statistically valid quantitative survey. A brief discussion and a reference are provided to address quantitative sampling designs. During the DRAFT phase of the Protocol, either method for determining PSA will be appropriate for conducting survey work. Both methods will be field-tested during the summer of 2003 to determine which method is the most applicable while providing the most reliable and consistent data regarding the presence/absence of listed mussel species.

I. INTRODUCTION

The Endangered Species Act (ESA) requires consultation with the Service for activities that are authorized, funded, or carried out by a Federal agency that may affect a federally listed species or its critical habitat. The Service consults with many local, State, and Federal agencies, as well as private entities, regarding the conservation and protection of federally listed species. The Service's role in coordinating with various entities in order to protect threatened and/or endangered freshwater mussels has significantly increased as instream construction, maintenance, and relicensing of new and existing structures has become more commonplace. Therefore, this Protocol is intended to provide standard operating procedures for establishing the presence/absence of federally listed species within a project area and documenting potential impact(s) of projects on listed species, as well as ensuring that the most conservative measures are being taken to protect threatened and/or endangered species.

The need for this Protocol stems from increasing impacts to streams in the Southeast due to urban expansion, development, and highway construction, as well as the need for a reporting framework to ensure quality data are collected. It is intended to be used for surveys in determining the presence/absence of federally protected mussels and/or the impacts to these mussels that would occur as the result of highway construction, impoundments, pipeline

crossings, dredging, channelization, and riparian land-use practices. These activities can alter stream characteristics, causing silt accumulation, loss of suitable habitat, stagnation, accumulation of pollutants, and eutrophication in the immediate area, and for an unknown distance downstream of the proposed project. The Protocol is also intended for use in conducting freshwater mussel status surveys on private, public, or other conservation lands.

In preparation of this draft Protocol, an exhaustive literature search was completed, and malacologists throughout the Southeast region were interviewed. Three proposed methods of determining PSAs (status quo, minimum lengths, and multiplier) were originally presented at the Coosa Summit meeting in Rome, Georgia on February 4-6, 2003, and in poster format at the 2003 Freshwater Mollusk Conservation Symposium in Durham, North Carolina on March 16-19, 2003 (Carlson *et al.* 2003). As comments were received, the status quo option was omitted from further consideration based on review of the compiled survey reports from the GDOT (Carlson *et al.* 2003). The GDOT survey reports indicated that relying exclusively on best professional judgement (as reported in the status quo option) did not produce consistent survey methods in the past.

Although this draft Protocol outlines specific methods for conducting mussel surveys at DOT project sites, it is intended to serve as a guideline and a tool and should be used in other mussel surveys that are requested or funded by the Service. All surveys should follow the standard operating procedures in this document. For some projects (i.e., land development proposals and dam relicensing, etc.), it will be appropriate to modify the PSA to include the entire area within the project footprint, plus an upstream and downstream buffer as determined by the minimum length or multiplier factor methods (coordination with the Service may be necessary to determine appropriate modifications to the PSA).

A standardized survey is important in creating comparable and consistent survey efforts, as well as providing quality assurance. The methods outlined in this draft Protocol were created to be specific, but flexible, to account for the site-specific nature of mussel surveys. Please note that this draft Protocol is a dynamic document subject to change and will be updated as relevant data become available. Specific survey methods will be field-tested in the summer of 2003 for feasibility and applicability in determining the presence/absence of federally protected mussel species within a potential project area.

Goals

1) Provide Quality Assurance/Quality Control measures for survey methods used to determine presence/absence of threatened and/or endangered mussel species
2) Provide Quality Assurance/Quality Control measures for mussel surveys when additional quantitative information is necessary to determine project impacts on threatened and/or endangered species within the project area
3) Provide comparable and consistent mussel survey methods, which will also allow for expanding the mussel survey Geographic Information Systems (GIS) database and updating Protocol procedures

II. STANDARD OPERATING PROCEDURES

A. Surveyor Qualifications

Personnel who will be conducting surveys should have sufficient knowledge within the basin they propose to survey. This includes species-specific biology and ecological requirements, and the ability to identify freshwater mussel species from the basin. A mussel surveyor should have sufficient experience, which includes documented field-time, and the ability to demonstrate skills in executing survey methods and locating and identifying federally protected freshwater mussel species. Furthermore, a surveyor should be able to document experience in the safe-care and handling of threatened and/or endangered mussels. Individuals familiar with southeastern freshwater mussels but not with listed species in the area to be surveyed, should work with a malacologist who has experience with the listed species. Documentation of field-time and/or a letter of recommendation regarding the surveyor's inbasin experience and their knowledge in surveying, handling, and identifying freshwater mussels (including threatened and endangered species) may be requested.

B. Permit Requirements

Prior to each survey, the surveyor will obtain a section 10(a)(1)(A) recovery permit from the Service. Under the ESA, a section 10(a)(1)(A) permit allows the permittee to handle federally threatened and/or endangered species for scientific purposes. The necessary scientific collecting permits from the appropriate State should also be obtained before surveying. Permission for stream access on private lands should be granted by the appropriate landowners prior to sampling.

C. Preliminary Research

Prior to each stream survey, the surveyor should conduct a thorough review of available resources pertaining to the potentially affected species of concern, candidate species, and threatened and/or endangered mussel species. Such resources include distributional maps, published journal articles, and field malacologists who have experience with the relevant species or drainage area. Other resources include databases maintained by Georgia Department of Natural Resources (Wildlife Resources Division- Georgia Natural Heritage Program), The Nature Conservancy, and the Service, as well as museums. Relevant information to review should include: identification keys (a suggested key is McMahon and Bogan 2001) or characteristics determining identification, historical distribution of listed mussels and previous collection locations, recovery plans, habitat descriptions, life history (especially spawning seasons), and applicable Federal Register documents.

Precipitation and U.S. Geological Survey (USGS) gage station data (if available in the project area) should be referenced to determine hindering factors (weather conditions,

increased flow) that could affect collecting conditions (i.e. turbidity, temperature, etc.). If gage stations are not available, every attempt should be made to determine the condition of the stream before the survey is executed to ensure conditions are appropriate for surveying. This may include contacting the local Department of Natural Resources, the Service, or other related natural resource offices. If the surveyor anticipates deviations from the Protocol, the surveyor should informally coordinate with the lead Service office for technical assistance regarding listed species, accepted survey methodologies, and timing of the survey.

Additional consideration should be given to prevent the spread or introduction of nonindigenous species while conducting surveys. Before moving between basins, all gear, including, but not limited to, wetsuits, collecting bags, boats and trailers, must be washed and dried and deemed free of mud and aquatic plants. Boats and trailers must also be scrubbed and washed down with chlorine bleach, and live wells must be emptied over dry land or in the basin where the water was collected, especially when they have been in basins where zebra mussels have been detected. The website for the Service's Aquatic Nuisance Species Task Force is provided for additional information (www.anstaskforce.gov).

D. Survey Methods

Qualitative and quantitative methods are commonly used for mussel surveys. Qualitative methods typically provide presence/absence data only; though these types of surveys have been demonstrated to produce more robust species lists, especially when the presence of a rare species is in question. Quantitative surveys can provide a multitude of data related to population demography and are necessary if an impact analysis is needed. Furthermore, both qualitative and quantitative methods provide information that may be pertinent in compliance with the National Environmental Policy Act and the ESA.

This draft Protocol defines and utilizes qualitative and quantitative survey methods in the following manner. Qualitative surveys will be recommended at ALL project sites with perennial streams. A second, quantitative, survey may be appropriate at a later date if federally protected species are found within the project area. The quantitative survey could be recommended if the Service needs information in addition to the qualitative survey data in order to adequately assess potential impacts to the protected species within the project area. The recommendation for a quantitative survey will occur on a case-by-case basis and will require consultation with the Service following a qualitative survey if federally protected mussels may be affected. The Service will review the data collected from the qualitative survey, project descriptions and possible impacts, literature, as well as consult with malacologists to determine the need for a quantitative survey. The surveyor may chose to bypass the qualitative survey and proceed directly to the quantitative survey where listed species are known to be present. Where federally protected mussels have been located or known to occur, adverse effects are expected, and data gaps exist, the Service will give the benefit of the doubt to the species when

prescribing measures to minimize effects, including incidental take. Therefore, conducting a quantitative survey may be more cost-and time-effective in situations where adverse impacts to listed species are probable, as it would allow the Service to review explicit, biological data.

1. Qualitative Surveys

In general, surveys should be conducted from the end of April to the end of October (exceptions are for special surveys requiring life-history data, etc.) to reduce the risk of high flow and low temperature. These time frames will be flexible based on unseasonable water flows and temperatures. The Service should be contacted if surveys are proposed to be conducted outside of these dates. If a survey was conducted two or more years prior to the present, an updated survey or re-evaluation may be recommended. All new surveys or re-surveys should follow the methods described in this Protocol.

Qualitative surveys should consist of visual and tactile searches of all habitats within the survey area to be searched, or prescribed search area (PSA). To determine PSA, see Section (E) of this draft Protocol. The PSA should begin outside of the bridge disturbance area, especially the scour hole. However, the disturbance/scour hole should be searched in addition to the PSA. If the survey is conducted to determine if mussels would be impacted by projects that do not involve linear crossings of the stream, the PSA should encompass the entire stream reach that will be directly affected by a project, in addition to a buffer zone upstream and downstream of the project site. The length of each buffer zone should be determined using Section (E) of this Protocol. Surveying should be conducted from downstream to upstream to minimize disturbance (i.e., turbidity) and should be conducted from bank to bank.

The qualitative survey should begin by conducting a visual search to examine dead shells along stream shorelines and all exposed areas. The visual search should be conducted in addition to a tactile search for individuals within the water and should be used in conjunction with the following techniques: 1) for areas less than an arm's length in depth, mask and snorkel combined with hand grubbing should be used. The use of view buckets is not appropriate due to the inconsistent nature of water clarity. 2) for areas greater than an arm's length in depth, SCUBA diving equipment should be used. The visual search, conducted in conjunction with the tactile search, should not be included in the actual length designated for the PSA. In other words, the visual survey should be conducted separately and in addition to the tactile search within the water.

A color photograph should be taken of all representative mussel species found during the survey. If federally protected species are located during the tactile search, they should be identified, enumerated, and measured for length. Shells should be measured with dial calipers to the nearest 0.1 mm for length. Shell length is

measured as the greatest distance from the anterior to the posterior shell margin (Appendix A). To minimize stress, all mussels should remain in a mesh collecting bag kept in the water and measured one-at-a-time. Mussels should not be exposed to air any longer than it takes to actually measure and photograph the animal. If more than 100 individuals of a single listed species are detected, measure lengths for the first 100 individuals and count the remaining individuals. The federally protected species must be returned, **unharmed**, to the exact location from which they were removed. Do not plant the mussel in the substrate; place the mussel on the substrate. The surveyor should only retain shells that no longer contain a live individual (a permit is necessary to retain shells).

Justifications as to why the standard operating procedures were not followed should be included in the final report, as well as any correspondence or communication with the Service regarding these deviations. The surveyor should collect general information regarding the survey area at the time of the survey. At a minimum, information that should be collected is indicated on the recommended data sheet (Appendix B).

2. Quantitative Surveys

Quantitative surveys may be recommended when federally protected species are found and more data regarding population structure or dynamics (density, recruitment levels, survivorship, etc.) are needed to determine threats and assess impacts before and after the proposed project has been completed. Quantitative surveys will consist of a statistically valid sampling design in which quadrat samples (with at least a certain proportion sampled using substrate removal techniques) are taken within a prescribed area. Appropriate designs may be chosen from Strayer and Smith (in review). A recommended data sheet with pertinent information is included in Appendix B.

The surveyor should coordinate with the Service regarding the quantitative design chosen from Strayer and Smith (in review) to ensure its applicability to the stream and ability to provide needed data. Justifications as to why recommendations were not followed should be included in the final report, as well as any correspondence or communication with the Service regarding quantitative methods.

E. Determining Prescribed Search Area (PSA)

This draft Protocol describes two methods which may be used to determine PSA. They are: 1) minimum length, and 2) multiplier factor. Until both methods are field-tested to determine which is the most feasible and adequate, the surveyor may choose to use either method. Below are descriptions of how the method should be applied and the applicability of each method for wadeable and non-wadeable streams.

1. Minimum Length

Description

Minimum lengths suggested in this Protocol were adopted from the National Water Quality Assessment (NAWQA) protocol and standards and also encompass the range of survey lengths suggestions from field malacologists. In wadeable streams: A survey length of 150 m (~450 ft) upstream and 350 m (~1,000 ft) downstream of the proposed project should be used as a minimum length. In nonwadeable streams: A survey length of 500 m (~1,500 ft) upstream and 1,000 m (~3,000 ft) downstream of the proposed project should be used as a minimum length.

The minimum lengths should incorporate appropriate mussel habitat(s), such as gravel and cobble substrate, islands, sand bars, muddy sand substrates around tree roots, sand/limestone, and pools, riffles, and runs, etc. If appropriate habitat(s) is not included in the minimum length, the surveyor should use their best professional judgement to extend the PSA (within reason) to locate and search appropriate habitat(s). Surveyors should also use their best professional judgement to further survey unique habitats. Additionally, if the surveyor determines the minimum length does not encompass all direct/indirect impacts associated with the project, they should use their best professional judgement to extend lengths as necessary.

2. Multiplier factor

Description

The average width of the stream multiplied by a selected factor should determine the PSA to be surveyed upstream and downstream of the proposed centerline. The multiplier factor is determined by the average linear distance that must be searched to detect maximum species richness at a site divided by the average width of a stream across that distance. Species-area curves used to determine the distance for maximum species richness are currently under development. Until they are developed, a multiplier of 60 times the average width of the stream should be used for PSAs downstream, while a factor of 40 times the average width of the stream should be used for PSAs upstream (please see below for method of calculating stream widths). Due to data gaps regarding the multiplier factor for mussels, these factors were selected based on coastal plain fish surveys (Paller 1995) and offer the most conservative multiplier factors for mussel species. The shorter upstream factor was chosen to coincide with the minimum length method in which upstream PSAs are shorter due to decreased project impacts upstream. During the development of the species-area curves, other multiplier factors used in mussel or fish surveys will be examined and compared to the factors suggest above. These include a factor of: a) 20 used in Haag *et al.* 2002; Meador *et al.* 1993; and Cuffney *et al.* 1993; b) 35 used in Lyons 1992; and c) 60 used in Paller 1995.

The distances between the five-averaged stream widths are determined by selecting five random transects from a random number table (0-100). Measurements proceed in a downstream to upstream manner in which the distance is measured between each random transect. At each of the five random transects, the stream width is measured bankfull to bankfull, perpendicular to stream flow. If the averaged stream width is greater than three meters after the five transects are averaged, an additional five random transects are selected and the process is repeated. Furthermore, the process will be repeated with each three-meter increment (i.e., measurements are taken at five random transects for sites with mean stream widths less than three meters, at ten random transects for sites from three-six meters, and 15 random transects for sites from six-nine meters). Islands, sand, and gravel bars should not be included unless they have been exposed by drought conditions and would normally be underwater.

III. DELIVERABLES

A. Early Coordination

Early coordination with the Service and DOT should take place prior to the survey and is an important aspect in determining whether appropriate survey techniques are being adhered to and/or ensuring that deviations from this Protocol will be accepted by the Service and DOT. At this stage, the surveyor may contact the Service for technical assistance regarding the project location, mussel species in the area, project impacts, survey methodologies, and length of the PSA. The Service office responsible for the area in which the survey will be conducted should be contacted for technical assistance. All correspondences regarding technical assistance to the lead Service office should be copied to the Service aquatic biologist in the appropriate region, as well as the contact person within the company or department for which the survey is being conducted.

If there are no deviations from the Protocol or need for technical assistance from the Service, it is recommended that the surveyor provide the Service with the basic information below and time frames the mussel survey will be conducted. This information can be informally provided to the Service via a brief letter and/or email, preferably 30 days prior to the start of the survey. Should the surveyor choose not to provide the Service with this information and not to engage in early coordination, the surveyor should be aware that the survey report may not be sufficient and a second survey may be requested.

Information to include in early coordination:

1. Preliminary Research

   State the purpose of the survey, and list the Federal species of concern, candidate species, and threatened and/or endangered species that may be expected to occur in

the drainage basin in which the stream(s) to be surveyed is located. Include the information required in II. C.

2. Survey Area Description

Provide a brief description of the proposed project that would impact the streams/rivers being surveyed. The stream reach(es) surveyed should be graphically represented on a 7.5 minute USGS topographical map. Provide a description of the area where the stream(s) to be surveyed is located, including physiographic area, general topography, land use, drainage basin, and potential suitable mussel habitat.

3. Methods

Provide a full text description of the equipment to be used; describe the method used to determine survey lengths, or PSA; list the person(s) who will be conducting the field survey and provide a brief summary stating their affiliations, qualifications, and all valid permits; indicate the date(s) during which the survey will be completed; list the person(s) who will confirm all identifications and provide a brief summary of their affiliations and qualifications. Include descriptions and justifications for any deviations from the Protocol (include any correspondences as an attachment).

B. Reports

At a minimum, the qualitative and quantitative survey reports should include information gathered during early coordination and the following:

1. Results

Provide a detailed summary of the survey results and copies of all data forms. Include summary tables of the species, shells, measurements, the areas where mussels were found, and water quality parameters taken. Provide photographs of representative stream reach(es) surveyed at each site and project location area. Photographs and survey forms should be attached as appendices.

2. Discussion

Briefly discuss the quality of the habitat(s) observed within the survey area and the suitability of these areas for supporting the threatened and/or endangered species for which the survey was completed. If species of mussels that were expected to be found in the survey area were not located, discuss possible reasons why the species were not found. If the species were found, describe how the proposed project would impact the species and identify possible methods to avoid these impacts. If listed mussels were found, discuss reasons why a quantitative survey was/was not

completed. Deviations from the Protocol should also be discussed and should be related to whether it aided in detecting presence/absence and/or in collecting quantitative survey data. Early coordination and consultation with the Service should be included, especially if it resulted in deviations from the draft Protocol, such as timing of the survey and determination of PSA. Written correspondences and/or emails can be included as appendices but should be explained as necessary.

3. References

Include all literature sources used in preparation for the survey and for the survey reporting including but not limited to journal articles, unpublished papers, and personal communication.

C. Distribution

Please send one copy of the final report (including copies of original field data sheets) directly to the U.S. Fish and Wildlife Service, Panama City Field Office, c/o Holly Blalock-Herod, 1601 Balboa Ave., Panama City, Florida 32405. Site-specific physical, chemical, and biological data will be incorporated into a consolidated GIS database that tracks mussel populations at survey sites. The database was established to serve as a host for data collected during mussel sampling/surveying in order to: 1) provide one system to combine records from various reports and published literature; 2) track ongoing survey sites and current population trends; 3) identify locations of past and present communities that support(ed) federally listed or other species considered imperiled; 4) determine where data gaps exist; and 5) aid in the decision-making process concerning habitat restoration, long-term monitoring, and permitting/consultation issues.

Additional report copies should be sent to: the lead U.S. Fish and Wildlife Service office; the Georgia Department of Natural Resources Natural Heritage Program; a State university library (suggested libraries include: Marston Science Library, c/o Vernon Kisling, University of Florida, P.O. Box 117001, Gainesville, FL 32611; and University of Georgia Institute of Ecology, c/o of Dr. Byron Freeman, Senior Public Service Associate, Institute of Ecology, University of Georgia, Ecology Bldg., Athens, GA 30602-2202; bud@trrout.ecology.uga.edu; 706-542-6032; Fax 706-542-4819), and any other entities as required by the State and/or Federal permits.

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APPENDIX A

Shell Measurement Diagram

To determine total length of a freshwater mussel, measure the maximum distance between the posterior and anterior shell margins (distance between the two lines). Photo Credit: Jerry Ziewitz

APPENDIX B

Recommended Field Data Sheets

MUSSEL SURVEY FIELD DATA SHEET

US Fish and Wildlife Service | Georgia Department of Transportation

Field Number:	**Project # and Description:**
Date:	
State:	**Begin Time:** **End Time:**
County:	**Drainage:**
Locality Description:	
Latitude: **N**	**Longitude:** **W**
Datum: NAD 27 NAD 83 WGS 84	
UTM **E**	**UTM** **N**
Surveyors:	**Specimens Identified By:**
Federal Permit #:	**State Permit #:**

Ambient Weather Conditions:		**Has there been rain in the past 7 days?** (Approx. Amount)?
Air Temp: **C/F**	**Water Temp:** **C/F**	**Conductivity:** **uS**
pH:	**DO:** **mg/L**	**Specific Conductance:** **uS**
Secchi*:	Turbidity*: ntu	PO4*: NO4*:
Water Clarity: clear tannic green/algae white/milky muddy		
Water Level: no flow low flow normal flow full bank flood		
Gage Height: Stream Federal/State Website		

Riparian Vegetation:	**Right Bank Buffer Width:**
	Left Bank Buffer Width:
	Bank Stability: stable unstable/eroding
Canopy Cover (%):	**Bank Height:**
Aquatic Plant Cover(%): algae submergent emergent overhanging floating standing trees	

General Land Use Description: natural old-field agriculture pasture silviculture recreation urban/industrial homesite waste disposal

Waterbody Description:

Riverine: stream spring sidechannel tailwater canal

Lacustrine: oxbow pond lake impoundment borrowpit

Palustrine: marsh swamp ephemeral pond

Stream Characterization:	
Stream Gradient: flat low moderate high	
Sinuousity: straight slight-meandering strongly-meandering braided	
Average Depth Upstream:	**Average Depth Downstream:**
Average Width Upstream:	**Average Width Downstream:**
Substrate Cover Estimate:	
soft silt-mud	bedrock/claypan
silt-sand mix	bedrock ledges/fissures
sand (0.125 - 1.9 mm)	vegetation
gravel (2 - 63 mm)	shred detritus, organics
rubble (64-256 mm)	leaves, small branches
boulder (> 256 mm)	logs

Stream Quality: fully functional somewhat impaired impaired

Is the stream on the 303(d) list? No Yes - **Which criteria were violated?**

Designated Use:

Stream Quality Definitions: Fully Functional – no indication of stress or disturbance in stream or adjacent area – diverse and mature fringing shrub-dominated cover - diverse and stable fish & wildlife habitat – gravel beds, submerged logs, undercut banks, riffles and pools – no channelization –

Somewhat Impaired – mild to moderate disturbances result in minor recognizable alterations – existing pipeline, road, railroad, other ROWs – provides fair fish and wildlife habitat – some erosion potential – some habitat diversity – fine sediment deposition predominates – flow and depth variation restricted – some channelization – trees, grass, or forbes dominate bank vegetation

Impaired – disturbances cause significant changes affecting plant species – mechanical alteration of plant species and/or soils – intense grazing activities – stream course channelization or ditching – exotic, nuisance, or invasive species – habitat diversity lacking – high erosion potential – flow and depth variation lacking - does not provide suitable wildlife habitat – grass or forbes dominate bank vegetatio

Items indicated by an * are not required.

Determination of PSA: (choose one)			
- multiplier	multiplier factor:	distance upstream:	distance downstream:
- minimum length		distance upstream:	distance downstream:

Survey Technique(s): (circle one)
tactile only
tactile with snorkel
tactile with SCUBA

Description of appropriate habitats:

General description of habitat morphology: obvious point/non-point discharges, type of road crossing, past alterations of the stream reach, etc.:

List of other species observed, including invasive species, and their abundance:

Explain/describe any deviations from protocol:

Include sketch map on back of this page. Include north arrow, flow direction, label any locations where listed species were collected, indicate and label any unique charactaristics or instream structures.